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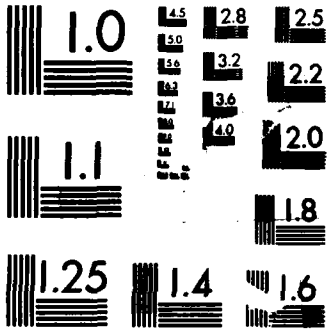


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ANNUAL SUMMARY REPORT

# Forces on Neutral Atoms Due to Electromagnetic Fields

Office of Naval Research

Contract N00014-83-K-0695

covering the period

1 September 1986 - 31 August 1987



Submitted by:

David E. Pritchard

September 1987

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
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This ONR progress report covers the period 1 September 1986 - 31 August 1987.

The construction of the superconducting magnetic trap was completed and, as a major breakthrough in the field, was used to trap large numbers of neutral sodium atoms ($\sim 10^9$) for periods of several minutes[1]. Our first successful run has represented an advance of several orders of magnitude compared to previous neutral trapping experiments, both in numbers of trapped atoms, and in trapping times achieved. The continuous loading process pioneered in this experiment has represented an important advance over previous pulsed loading schemes, as it has permited the accumulation of much larger numbers of atoms in the trap.

At present, the trapped atoms are being used for several experiments. We have studied the fluorescence spectra of the trapped atoms using a weak "probe" laser beam ( $I = I_{sat}/10^4$), which does not affect the trapped atoms appreciably. We are currently attempting to study Doppler cooling of the trapped atoms, using this spectrum to measure the temperature of the atomic sample. ~~We have~~ also observed, for the first time, the effect of gravity on trapped atoms: the trapped atoms do not accumulate at the minimum of the magnetic field, but at the minimum of the total mechanical potential obtained when including the effect of gravity. In the near furure we plan to use RF resonance to study the trapped atoms, and ~~use~~ optical-RF "cyclic cooling"[2] of the atoms to attempt to achieve sample temperatures $\leq 10^{-6}$ K.

1. V.S. Bagnato, G.P. Lafyatis, A.G. Martin, E.L. Raab, R.N. Ahmad-Bitar, and D.E. Pritchard, Phys. Rev. Lett. *58*, 2194 (1987).

2. D.E. Pritchard, Phys Rev Lett. *51*, 1336 (1983).

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